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VARIATION AND HEREDITY IN BRUCHUS QUADRIMACULATUS, FABR. (COLEOPTERA).

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INTRODUCTION.

This Bruchid is of great importance since it is found wherever cowpeas are grown. It has been introduced into Canada from the United States. Students of heredity and variation might well utilize for original research almost any bruchid since they usually breed readily. There are at least four North American species which are especially adaptable for experimental breeding; *Bruchus quadrimaculatus* Fabr. the "four-spotted cowpea weevil;" *Callosobruchus chinensis* Say, the "common cowpea weevil;" *Acanthoscelides obtectus* Say, the "common bean weevil;" and *Zabrotes pectoralis*, the common bean weevil of Panama. These will all breed in the cowpea, *Vigna catjang*. They may produce a generation within three weeks under optimum temperature. These insects have the habit of shamming death. During the death feint the insects can be critically examined with a hand lens. Time is also given for the determination of the sexes.

The breeding cages are glass vials, one inch by three, filled with cowpeas and plugged with cotton. The cowpeas may be sterilized by keeping them for one hour in a mason jar kept at a temperature of 50° C. Humidity may be provided by placing several culture bottles in a glass battery jar containing about one inch of water. This jar should be covered with a glass plate. Virgin females may be easily obtained by removing them with a knife from the cowpea in which they have lived during the larval stage. Black-eyed cowpeas should be used if it is possible to obtain them, because the adult beetle lying just beneath the white integument covering the cowpea will appear as a round dark spot, and thus be more readily removed. Single pair matings should be used. The adults have a complete digestive system and will take water with apparent relish when it is supplied. Feeding is not necessary, the female being able to lay the usual quota of eggs without partaking of any nourishment. The average number of eggs for fertilized female is less than a hundred, while an unfertilized female rarely deposits any. A drop of honey-water added to the breeding vial will, however, increase the length of life and augment to a slight extent the number of eggs deposited.

VARIATIONS.

During eight years of search among this species for variations which were inherited more than a score have appeared. The earliest mutations observed consisted of differences in elytral coloration, which is normally tan in both sexes. The wild type female has two black spots bilaterally located on each tan elytrum. The male of this type is also tan in color but non-spotted. In less than three years three variations have appeared among the females. These elytral ground colors were designated red, black, and gray. The male although breeding true for these respective female colors, remained with brown, non-spotted elytra. These sex dif-

ferences have been called sex-limited characters. Genetically these three different mutations belonged to a multiple allelomorph series with the following order of dominance, red, black, gray, and tan, the last named being the original gene in the wild type from which they mutated.

At a later date four red spots appeared on the elytrum of the female instead of the normal black spots. The males however retained their original appearance, hence these allelomorphs were described as sex-limited, the red spots being dominant to the black ones.

Another interesting mutation concerned with elytral spotting occurred asymmetrically in homozygous cultures of females, having two black spots on one elytrum and two red spots on the other elytrum or vice versa, equal numbers being dextral and sinistral. The males again remained non-spotted. When mated with normal, four spotted females and normal males, this bilateral, reversal asymmetrical trait is recessive to normal.

Recently another sex-limited color variation was observed. The two bilateral posterior spots on the elytra of a female mutated to red, while the two anterior ones remained black* which is the normal color for all four spots. This trait was not visible in the male. The character was inherited but the method of its inheritance is unknown. By inbreeding several females showing this variation were produced each generation; it has been impossible to obtain pure strains.

Variations in asymmetry were most frequent, sixty-three mosaics have appeared. Mosaics as used here indicates insects as those having an elytrum of one color on one side and of a different color on the other, or with the tissues of some small part of the body showing characters different from those in the rest of the body. These have been interpreted as caused by somatic mutations, since a gene mutation can take place in a somatic cell although it is not inherited in animals. Since all mosaics so far discovered have been concerned with sex-limited characters not visible in the male, all bruchid mosaics discernible were females. Two unique variations, one plain black and the other plain red, have appeared. The males for each character were non-spotted tan. By inbreeding, homozygous cultures carrying both characters, were obtained. Their inheritance is unknown.

Another most interesting mutation was called apterous. It was visible only in the female and was therefore regarded as sex-limited. The elytra were entirely wanting or only appeared as vestigial remnants at the wing bases. The males bred from apterous females were long winged. The wild type male and female are always supplied with long wings. The apterous mutation appeared at three different times during an interval of eight years. When the apterous trait was crossed with the normal type the latter was dominant, the ratio being six normal to one apterous. A degree of sterility was manifested in all apterous cultures as shown by reduced egg production inhibiting the normal mendelian ratio.

Conditions were reversed in the mutation called macula. This trait was visible in the male while the female was phenotypically the counterpart of the wild female. In the macula mutation a faint bilateral spot was clearly discernible on each elytrum of the male. This trait was a dominant one.

The last sex-limited mutation discovered was that of a female having a red pronotum instead of a black. When insects from pure lines of this mutation

were mated with normal insects, the male progeny had normal black pronota. There are many mutations, however, which are uniformly seen in both sexes; variations in the ventral color being one. The normal insect is tan ventrally but pure cultures of insects which are gray or red ventrally have been obtained. Experiments are being conducted to determine their inheritance. Another mutation visible in both sexes is white eye color. This only appeared once. It was accidentally destroyed before its genetic behavior could be ascertained. Long and short wing differences are unique variations always manifested in both sexes. Two variations, one gray, the other tan, have also been discovered for leg color. The antennal variations differ, one of which is gray, the other brown. The heredity of these antennal differences is not known. Body shape has two distinct types described as long and oval. These are distinct from dwarfed adults produced by the overcrowding of the larvae. Other mutant traits have been found in the eggs. Small, transparent eggs mutated from the large normal viscid eggs, but their inheritance has not been determined. Certain long-winged females were isolated which produced on the average six eggs as compared with the wild type which averaged eighty-nine eggs. In their genetic behavior, as showing partial sterility, they resembled the apterous mutant type. Sex-linked lethals were discovered giving a two to one ratio.

GRISDALEMYIA, A NEW GENUS OF TACHINIDAE (DIPTERA).*

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The two species described in the present paper are so well characterized that I have no hesitation in proposing a new genus in a family already overburdened. No host is known for either of the species, both of which are described from uniques.

Grisdalemyia new genus.

A peculiar genus, evidently most closely related to *Alaskophyto* Tns. but with bare parafacials and no trace of bristles at base of third vein.

Head long, the face very strongly receding on upper three fourths, the oral margin slightly produced; cheeks three-tenths to one third the eye-height; frontal vitta as wide or wider than parafrontal, much wider in ♀, ♂ without orbitals, the front less than one third eye-width, in the ♀ about four-fifths as wide as eye and bearing two pairs of proclinate orbitals; ocellars present; outer verticals absent in ♂. Eyes pilose. Palpi gently broadened to apex. Third antennal segment not over one and one-fourth times as long as second, the antennae reaching to lowest fourth or fifth of face; arista bare, large on basal fourth, the basal segments very short. Oral vibrissae strong, the facial ridges not bristly on more than lower fifth; cheeks clothed with sparse long hairs or bristles. Thorax with two pairs of anterior acrosticals the posterior pair in front of the posterior presutural dorsocentral; three presutural dorso-centrals; post-humeral and posterior sub-lateral bristle absent; four posterior dorso-centrals, two or three acrosticals and two intra-alars; sternopleurals 2:1. Scutellum with three or four pairs of strong marginals, the apicals absent or hairlike, the terminal pair of bristles somewhat divergent; a

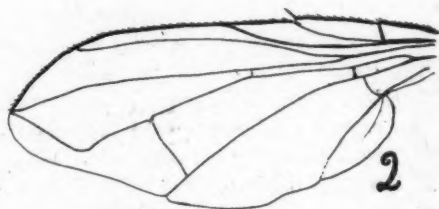
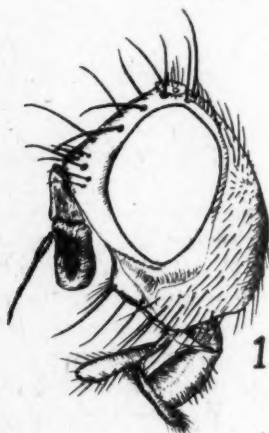
*—Contribution from the Division of Systematic Entomology, Entomological Branch, Dept. of Agric., Ottawa.

pair of weak discals. Propleura bare; infra-squamal spinules absent. Front tibiae with three strong postero-dorsal bristles and several hair-like ones; middle tibiae with three antero-dorsal bristles. Pulvilli of ♂ almost or quite as long as fifth abdominal segment, much smaller in ♀. Wings with the apical cell open, terminating a little before the wing-tip; fourth vein with rounded bend, the curve sometimes carried a little backwards; third vein curved backward apically; no bristles on base of third vein above or below; discal crossvein joining fourth vein beyond the middle of penultimate section; length of ultimate section of fifth vein less than half as long as discal crossvein. Costal spine moderately developed. Abdomen short, oval, broader than thorax, gently convex, the whole of the two apical segments with discals, the second with discals on median portion and more or less distinct row of marginals; first segment with one or two pairs of marginals. Female without piercing ovipositor. Genotype—*G. bigelowi* n. sp.

I take pleasure in naming this genus in honor of Dr. J. H. Grisdale, Deputy Minister of Agriculture, whose interest in Entomology has greatly assisted the development of the Canadian National Collection of Insects.

Two species belonging to this genus are before me. They may be distinguished as follows:

Palpi blackish; scutellum with four pairs of marginals; abdomen shining black, not noticeably pollinose *bigelowi* n. sp.
 Palpi reddish yellow; scutellum with three pairs of marginals, the abdomen conspicuously grey pollinose, the bristles rising from darker spots.....



..... *aldrichi* n. sp.
***Grisdalemyia bigelowi* n. sp.**

(Figs. 1 & 2.)

Length, 6 mm. *Female*. Body wholly black. Head grey pollinose; frontal vitta opaque, twice as wide as parafrontal at upper third; three pairs of orbitals the upper pair divergent; facial ridges bristly on lowest fourth. Second and third antennal segment of about equal length.

Mesonotum quite thinly grey pollinose, the dark vittae indistinct. Humeri

and notopleura and pleura thickly grey pollinose. Scutellum thinly pollinose.

Legs black. Wings cinereous hyaline, the veins largely and base of wings yellow. Squamae and halteres yellow.

Abdomen shining black; first segment with two pairs of bristles, a discal and marginal pair; second with several discals and weak marginal row. Sternites not hidden.

Holotype—♀, Low Bush, Lake Abitibi, Ont., June 30, 1925, (N. K. Bigelow); No. 1953 in the Canadian National Collection, Ottawa.

***Grisdalemyia aldrichi* n. sp.**

Length, 5.75 mm. *Male*. Black, the palpi reddish yellow. Head grey pollinose, the face silvery. Parafrontals nowhere wider than frontal vitta, for most of their length less than one third or one fourth as wide; frontal vitta reddish brown; fine hairs between the bristles in each frontal row. Ocellars and post-ocellars long; occipital cilia long and fine, no outer verticals. Cheeks about one third the eye-height; third antennal segment a little longer than the second. Parafrontals strongly narrowed below.

Thorax grey pollinose, the mesonotum less thickly so, the dark vittae not distinct. Bristles long and fine. Scutellum with only three pairs of marginals, the terminal pair separated by twice the distance separating it from the preceding pair, the apicals absent (or represented by one or two fine hairs).

Coxae and femora greyish pollinose. Wings cinereous hyaline, some of the veins brownish yellow, the wings not conspicuously yellow at base. Squamae yellow with whitish sheen. Halteres yellow.

Abdomen conspicuously grey pollinose with the apices of the segments broadly blackish and each bristle rises from a dark spot. First segment with a pair of discals and widely spaced marginals; second with three or four pairs of discals and incomplete marginal row; third segment with complete arched row of discals and slightly arched marginal row; fourth with two arched rows of discals and weak row of marginals. Genital segments somewhat large, bearing long hairs. Bristles of abdomen long and fine.

Holotype—♂, Stanford University, California, Feb. 28, 1906, (J. M. Aldrich); in United States National Museum, Washington.

ON THE BIONOMICS OF SOME HYMENOPTERA FROM A BUR OAK
CYNIPID GALL.

BY W. V. BALDUF,
University of Illinois.*

Some of the most complex and at the same time most interesting phases of insect life are the various sorts of inter-relations existing among the species associated with plant galls. An example of this came to the writer's attention in the spring of 1923, when an abundance of galls was found on the bur oak, *Quercus macrocarpa* Michx. This fairly common gall proved to be a veritable world in itself, which even though now imperfectly understood has not only proven to be fascinating with reference to the identity and present day inter-relationships of the species forming the micro-society, but phylogenetically, it constitutes also a synopsis, as it were, of a long performance whose growth and perfection probably

*—Contributions from the entomological laboratories of the University of Illinois, No. 99.

involved untold centuries. In the present status of the gall life are represented fine adaptations resulting from conflicts and adjustments that have gone on for ages, as well as possible changes in the functions performed by the different species, — all processes having culminated in the intertwining of the several life histories in such a manner that each species now present succeeds in surviving its limitations.

LIFE HISTORY OF THE GALL FORMER

The details of the development of the cynipid producing the galls from which the insects treated in this paper were reared are not known at this time. However, Doctor A. C. Kinsey has through correspondence made available to the writer his observations on the cycle, which indicate the general conditions to be about as reproduced here. As in the instances of many other gall forming cynipids, the present species involves two forms, each producing one generation annually, and alternating with the other. The forms concerned are *Disholcaspis flavipes* (Gill), and *D. mamma* (Walsh).^{*} The *flavipes* form passes the winter as eggs deposited in the buds, inside the embryonic leaf tissue, by the *mamma* insect in the latter part of November. The eggs give rise to *flavipes* larvae late in the following April, probably not until the young leaves begin to grow, and the young insects are carried out with the leaf as it develops. The *flavipes* gall therefore appears on the midrib of the oak leaf, the construction lacking the marble like size and shape of the alternate gall. These galls and insects develop during May, June, and the early part of July. In the latter time the insect is mature and emerges from the gall. About the middle of July the perfect *flavipes* lays the eggs from which the *mamma* form develops. These eggs are placed in the natural splits in the bark of the twigs. Hatching takes place in latter July, and the *mamma* larva and its gall grow very rapidly, and reach maturity in September. During October and the first half of November, the *mamma* insect becomes adult, cuts its way out of the gall, and oviposits in the buds of the host tree.

SCOPE OF THE PRESENT ARTICLE

This paper is concerned with recording the data from observations on the bionomics of the several species of Hymenoptera, exclusive of the gall former itself, occupying only the *mamma* gall. The possible connections of these species with the gall and activities of the alternate form *flavipes*, has not yet been determined. Other features that would form essential portions of a complete account of these insects are the general facts in the life histories of the parasites and inquiline in the gall of *D. mamma*, and the exact part some species play in the economy of others. However, such desirable data must await future opportunities for careful observations under natural conditions.

METHODS OF STUDY

The mature *mamma* galls studied were collected mainly from one heavily infested tree near Urbana, Illinois, in the spring of 1923 and again in 1924, before the inquiline and parasitic insects treated here were due to emerge, and kept in indoor cages, where the inhabitants were permitted to develop. The most pro-

^{*}—The helpful suggestions and criticisms made by Dr. A. C. Kinsey of Indiana University are gratefully acknowledged. Many thanks are also due to Messrs. Rohwer, Gahan, Cushman, and Weld, of the U. S. National Museum for the determination of the insect material.

ductive method was to dissect the galls, isolating the insect larvae derived from the distinct parts of the gall host, and rearing them under conditions in which they could be observed directly whenever desirable.

THE GALL OF DISHOLCASPIS MAMMA

The newly matured galls of the *mamma* insect remain attached to the twigs of the host tree during the winter, and even persist there two and probably more years after maturity. The new full-sized gall is almost spherical, approximates an ordinary marble in size, and has a reddish-brown color and a rough surface. The proximal portion is modified into a pair of lobes which clasp the oak twig. For present convenience the gall may be regarded as consisting of two parts.—the monothalamous larval cell, and the woody outer gall. The larval cell is egg-shaped, very light brown in color, approximately 5.3 mm. long by 3.5 mm. in greatest diameter. This cell is the abode of the cynipid larva during its development, and is never occupied by more than one of these gall formers. The distal end of this case is distally more fragile and penetrable than the other, and is the region through which the occupant comes forth. The cell lies free in the center of the gall within a surrounding wall of woody tissue which is solid, yet somewhat corky in consistency, enabling those insects peculiar to it to emerge by aid of their mandibles. Especially the proximal lobes consist of such a depth of corky substance that make them well suited as a source of shelter and food. The fauna of the gall is likewise divisible into two quite independent groups of insects corresponding to the two-fold structure of the gall. The larval cell is at first occupied by the gall-making cynipid larva and pupa. However, this larva is not commonly supplanted by one of several of its parasites before it has run its life course. The woody outer portion is inhabited by a series of species characterized by rather close taxonomic affinities and perhaps not widely different habits.

THE GALL MAKER GROUP

By the gall maker group is to be understood the several species that center about the gall forming cynipid, *Disholcaspis mamma*. The relationship here is entirely either primary or secondary parasitism. Hence, *D. mamma*, like many other gall makers of its family, is limited in its reproductivity by various hymenopterous parasites. It is believed however, that such reduction in this species in 1922-1923 amounted to less than forty percent of the cynipid larvae.

Syntomaspis racemariae Ashmead.

Its most effective parasitic enemy is probably *Syntomaspis racemariae* Ashm., a member of the chalcidoid family Callimomidae. The female body is between four and five millimeters long, and metallic with an ovipositor measuring eight millimeters, and blue in color. The male is of the same hue, but only about half as large as the female.

The majority of galls collected in April have a lateral exit hole 1.5 to 2.0 mm. in diameter, which is evidence that the adult gall-former has emerged. Similarly, eight month-old galls with no such holes may be regarded as signifying that the gall former either died for physiological reasons or was killed by a parasite. It is estimated that less than one third of the galls formed in the previous year were holeless in April, 1923. And again, probably less than half of the parasitized galls contained larvae of *S. racemariae*. The life history of this parasite is suggested by the following observations made on one male specimen in 1924. The larva

remained in this stage until July 7, 1924 and like all other *S. racemariae* larvae, was full grown when taken in April. The parasite grub occupies the larval cell formed by the cynipid host. It is almost three millimeters long, robust, clouded white; head quite distinct and the oral portion extending back over the base of the thorax, mandibles small and functional; middle portion of body abruptly thicker than either end, the caudal segments tapering. Pupation occurred on July 8. During the pupa stage the body color gradually changed through brown, and by July 18 had assumed a quite normal metallic blue coloration. The adult appeared on July 20, hence the pupa stage was twelve days.

Rearing insects under artificial conditions where the chief differences from a state of nature are a constant temperature and a subnormal moisture, is recognized as probably prolonging the time required for maturing these insects. The following records are to be interpreted in terms of this fact. According to rearing notes on a 1923 series of this species, the earliest adult emerged from its gall on May 18, and others on May 20, May 24, May 30, and June 5, and two others remained alive and active until June 29. The disparity in the records for 1923 and 1924 adult emergence is attributed to the annual differences of the spring weather. The adults were then abroad at least 41 days under cage conditions, and the brood probably lives several weeks out of doors. The habits of the species at this time are not known. Presumably it needs to find a host soon after it reaches maturity, but whether it parasitizes the alternate gall insect *flavipes*, or seeks elsewhere than the oak for a subject can not be stated now. Whether one or two broods occurs is another matter to be determined. The possession by the female of a long boring ovipositor implies that the exact situation into which its egg is inserted is not of a superficial character. Ashmead (1) reported *S. racemariae* reared from the cynipidous gall insect *Amphibolips* (*Cynips*) *q. racemaria* Ash., which, according to Kinsey, is a black oak genus of gall makers, whereas *Disholcaspis* is peculiar to white oak. The occurrence of uniformly large larvae in April argues that the species winters in the full grown state.

Tetrastichus sp.

The insect obtained in largest numbers from the larval cell of this gall is an unnamed species of *Tetrastichus*, another chalcid, and of the family Tetrastichidae. The adult of *Tetrastichus* sp. is less than three millimeters long, and blue in color. During the spring months it has always been found in the mature larval state in masses held together by the moisture of the individual bodies, and ranging from twelve to thirty-two larvae per gall. When mature the larva has a length of one and six tenths millimeters and a maximum width of seventy hundredths millimeters. The body is bare, tapers slightly at each end, is rounded at the tips, and has a light straw color. The first pupae were seen on April 28, in 1923, the exact time of transformation being unknown, and in 1924 the earliest record was June 18. The species was in the pupa stage until May 25, 1923, a period of twenty-seven days, and until June 25 in 1924, a record of only one week, which of course does not represent the entire duration of pupation. Likewise, the period of adult emergence in 1923 was from May 7 to June 7, or one month, and in 1924, from June 30 to July 7. The insect was therefore abroad in the imaginal stage from May 7 to July 15, or almost ten weeks, in 1923.

Pupation takes place in the larval cell of the gall, where the larval stage is

spent. At the time of shedding the last larval skin, the faecal contents of the alimentary tract are thrown off in the peritrophic membrane as is characteristic of many Hymenoptera. The small black pellets lie together at the posterior end of the pupa. During the transition process, the insect undergoes the color changes generally found in other insect pupae, and which if studied carefully for each species may probably serve as reliable indicators of species or age at any time. In changing from the cloudy white of the larvae, the eyes of the pupa become pink, then red, and later brown or black. The abdomen is the first region to become dark, and the development of black goes from this point forward on the body. Many minute changes are known also to occur.

When the insect becomes adult a small hole is chewed through the soft end of the larval cell. This hole assumes various shapes that reflect the activity of the insect. Often it is single and circular, suggesting that only one insect was working. The adult emergence records indicate that a given mass of larvae does not reach the pupa stage simultaneously, hence one *Tetrastichus* may be out and make an exit before the rest are active. However, not uncommonly the aperture takes the form of a figure 8, with varying degrees of division between the two circles of the figure, which may be taken to indicate that two insects may work out at the same time. It is possible that the several adults alternate in the task of providing a way out. Later comers probably find the way already prepared for their exit. Having penetrated the wall of the larval cell, the insects emerge into a narrow interspace between this cell and the woody outer layer. Beginning here, the several insects present seem to make a broad excavation, which soon becomes narrowed to a central point, and a single cylindrical tunnel just large enough for one insect to pass perforates the outer gall to the exterior. In one instance noted, the tunnel branched just before it reached the surface and opened to the outside through two holes.

One lot of adults was kept under observation without food or drink, and water was made available to another lot of the same age at the same time, to determine the effect of water or the lack of it upon longevity and the probable success of the insects in nature. The results were not distinctive, for some of both lots lived seven days. During this time the procedure preliminary to mating was noted in the case of five days old insects. The male stood on the female's back with all six feet, waving his antennae briskly, while the antennae of the female were held still and extended almost parallel, with their tips sometimes touching the face of the male. When the female began walking, the male moved forward and pressed the bases of her antennae with his own, at which the female halted again. Copulation was not observed.

What is the relation of *Tetrastichus* sp. to the other insects obtained from the larval cell? There are two possibilities—it is either a direct parasite of *D. mamma* or of *S. racemariae*; that is, either a primary or secondary parasite of *D. mamma*, with the circumstantial evidence pointing strongly toward a relationship of primary parasitism upon the *mamma* insect. Following are the facts that lead to this opinion. The adult of *Tetrastichus* sp. appeared from May 7 to June 7, 1923, and June 30 to July 7, 1924. The *flavipes* insect has in general reached the adult state in June and deposits the eggs from which the larva of the *mamma* alternate arises during July. The concurrence of the adult *Tetrastichus*

and these eggs therefore suggests that the parasite attacks its host in the egg stage or soon thereafter about midsummer. Another feature in support of this view of primary parasitism is that *Tetrastichus* is a tiny species presumably incapable of penetrating a barricade of gall tissue such as is formed soon after the *mamma* larva hatches. Because *Tetrastichus* has been found as a larva in the *mamma* gall in April and most of May, indicates that it hibernates as a full-sized larva. This may mean also that *Tetrastichus* is not parasitic on the alternate gall maker *D. flavipes* unless it has two generations,—one adapted to the life history of *mamma*, and the other to that of *flavipes*.

It has been suggested that *Tetrastichus* sp. may be polyembryonic. The larvae occur in masses of twelve to thirty, and all larvae of a given mass are of quite uniform size. The carcass of the host was represented by some unidentified parts that did not enclose the mature larvae. Cocoons are not formed, and the pupae lie in a heap within the larval cell which is snugly filled by the mass of *Tetrastichus*.

Ten galls were dissected previous to the pupation of the larvae. Five of the ten galls contained larvae. Both males and females were obtained from each of the galls, as follows, the first of each three numbers given representing the males, the second the females, and the third the total of both sexes from each gall: 2, 13, 16; 6, 9, 15; 1, 12, 13; 3, 14, 17; and 1, 12, 13. Of the 74 individuals, 14 were males and 60 were females. The preponderance of females is in accord with the findings of Patterson (11 and 12) and Leiby (13) in their studies of mixed broods among polyembryonic insects.

The generally accepted principles and newer theories regarding polyembryony as it pertains to the present case are summarized here. Such mixed broods arise from two or more eggs, one or more of which are fertilized, these developing females, while the rest are unfertilized and give rise to males. Leiby (13) cites what he regards as "sufficient evidence to demonstrate beyond much question that fertilized females may produce either a male or a female brood." Patterson (11 and 12) suggests that mixed broods in which a very small percentage of males occur may arise from a single fertilized egg, but this possibility has not yet been demonstrated. The suspicion that *Tetrastichus* sp. may be polyembryonic therefore seems strengthened by the general agreement between its known habits and the general principles underlying this phenomenon.

Epiurus indagator Cresson. *Ichneumonoides*

On several occasions while dissecting galls, a distinct structure was found in the form of a whitish silken tube built upon a large opening cut through the distal end of the larval cell of each *D. mamma* gall concerned. The tube led almost to the outer surface of the gall, and was found in one instance to be occupied by an elongate pupa, whose structure by comparison with reared adults proved quite conclusively to be a specimen of an ichneumonoid species. In two other instances, only the shed pupa skins remained, one of which had deserted its tube during the pupa stage and occupied a subsurface excavation in the outer gall that was mined in the manner characteristic of a clerid larva found preying upon the inquillines of this gall. From a jar of galls two adults of presumably this species were obtained. These were determined by Mr. R. A. Cushman as *Epiurus in-*

dagator Cresson, Ichneumonidae, a medium sized species as compared with the average individuals of this family.

The living pupa was found in the gall on May 20, 1924, and an empty pupa case on the same date. The two adults were obtained on April 27, 1923.

In interpreting these records the wide differences in the spring weather of these two years must be considered, the growing temperatures of 1924 being much retarded as compared with the previous season. When the adult emerges it obviously chews through the remaining thin, woody, outer layer of the gall that confines it, and a circular cap of silk, which is probably also gnawed off, remains hinged to the free end of its cocoon. The larval cell of the gall maker in one instance was four and five tenths millimeters long, which reached within one millimeter of the exterior of the gall. The larva bores out of the gall only as far as is necessary for its own transformation, and makes no provision for the escape of the adult. The larva may be capable of confining itself to the larval cell of the cynipid gall maker, but an addition is necessary to accommodate the elongate pupa of the *Epiurus* developing there.

The fact that the mature larva works through woody substance is of significance in that it may be under necessity of taking plant food to supplement the supply of fleshy food which it derives from the cynipid host. In this connection it is of interest to note the observations cited by Morley (2) on other species of this genus. He quotes a hint from Dr. Giraud to the effect that the larva of a species reared from galls of *Triticum repens* for at least a part of its existence, subsists upon the purely vegetable tissues of the gall itself. According to Cameron in the same paper, the larva of *E. gallicola* Morl., found in the galls of the sawfly *Nematus viminalis* Hartig "was observed to increase appreciably in size and bulk for a considerable period after finally consuming the host larvae; presumably this could only be effected by means of the gall tissues, which in one case seemed to be preferred to those of the sawfly, since both host and parasite were found living side by side in the same gall."

In the present observations, *E. indagator* was the only species of the larval cell parasites found that emerges even in part from that case in the larval stage. To do so, whether to enlarge the cavity to accommodate the longer and more slender pupa, or to derive additional food for its own maturity, presumably the latter, it is necessary for the larva to bite off woody substance, and because no sawdust-like remains were found in the gall, indications are that the gall material was swallowed, and may have had a part as food for completing the larval stage. If this be the case, it not only confirms the observations of Giraud and Cameron, but may represent an instance of imperfect adaptation of parasite to host and a subsequent adjustment to the condition of inadequate animal diet made possible by the capacity of the parasite larva to utilize wooden substance, or perhaps in other words, to revert to its earlier phytophagic habit under pressure of necessity.

The bionomic status of *E. indagator* in this gall association during the annual period can not now be stated with completeness. Its presence in the almost mature galls of *D. mamma* in April indicates that the winter is spent there, and that it is parasitic upon one or more immature stages of this form of the gall

maker: but whether another generation develops on *flavipes* is unknown at this time. *Flavipes* is at the hatching stage in late April, and soon forms a gall; the short, robust ovipositor of *E. indagator* seems admirably fitted for inserting eggs into woody tissue.

Other records for this parasite show it to be better known as an enemy of lepidopterous larvae; among the hosts reported attacked are the grapeberry moth; *Polychrosis viteana* Clem. (3), the fruit tree leafroller, *Archips argyropila* Wlk. (4), the striped peach worm, *Gelechia confusella* Chambers (5), the pupa stage of the white marked tussockmoth, *Hemerocampa leucostigma* S. and A. (6), the pine tube moth, *Eulia pinatubana* Kearf. (9), and the red banded leaf roller, *Eulia velutina* Wlk. (10). The ovipositor has therefore been put to uses other than that for which it may have been originally fitted. That is, the primitive habit would seem to have been to insert eggs into woody tissues. In this respect the host-parasite relation of *D. mamma* and *E. indagator* indicates a recapitulation of the earlier habits of the latter, whereas the common use of the boring device for ovipositing in softer animal tissue at present certainly represents a much more recent development. The existence of other hosts than the *Disholcaspis* forms on bur oak, not only points to a considerable flexibility in the habit of *E. indagator* but also may mean that the parasite is not dependent on *D. flavescens*, on the contrary migrating here and there between the *D. mamma* and the caterpillars, if it has more than one brood per year. Many individuals may possibly also develop entirely independent of the cynipid forms.

Synergus obtusilobae Ashmead.

A fourth species involved in the *Disholcaspis mamma* complex is another member of the cynipid family, namely *Synergus obtusilobae* Ashm. It possesses the dull colors of the family, being light brown with the dorsum of the abdomen dark brown, and about four millimeters long. In a series of ten galls whose larval cells were isolated from the woody outer portions, one larva, which proved to be *S. obtusilobae*, was obtained. The larva occupies the larval cell of the host gall. Pupation of three larvae was seen to begin on May 23, 1923, from which it became known that the pupa stage lasts 16 to 17 days. Transformation unquestionably also took place after this date and presumably also previous to that time. The period of adult emergence of the brood, as far as records were obtained, extended from May 25, 1923, to June 9, 1923, whereas in 1924, one specimen appeared on July 25.

The galls from which *S. obtusilobae* came in all instances particularly noted, possessed larval cells that were rigidly embedded in the woody outer portion of the gall, the galls lacking the characteristic interspace present in galls from which *D. mamma*, *S. racemariae*, *Tetrastichus* sp., and *E. indagator* emerged. This condition suggests that somewhere in the life history of the gall the whole gall stopped growing because the gall maker died, and on account of its death the larval cell never separated from the outer portion. Doctor Kinsey states that the gall maker must apply its stimulus continually to have the gall mature. The galls from which *S. obtusilobae* were reared have the same reddish brown, rough surface peculiar to the normal mature galls of *D. mamma*, excepting that the former are smaller. Inasmuch as, according to Kinsey's observations, the gall maker is practically the sole determiner of the form, surface and color of the gall, this

points to the deduction that the galls inhabited by *obtusilobae* are in reality *mamma* made galls. Furthermore, the discrepancy in the size of the galls compared above, must be attributed to the activity of *obtusilobae* as a parasitic agent removing the stimulus of the *mamma* larva gall. The range of time in which *obtusilobae* adults appear make it possible that this species injects its eggs into the very small gall of *D. mamma*, and inasmuch as it winters as larva in the host gall and does not mature till May and June or even later in some years, it appears that the alternate form *flavipes* escapes attack, unless *obtusilobae* might possibly have a special form or brood adapted to *flavipes*.

There is quite no likelihood, therefore, that *obtusilobae* forms an independent gall on the bur oak, and this species, on the contrary, constitutes an exception to the general statement made by Gillette (7) that "the members of this genus (*Synergus*) are all inquilines, or guest-flies, inhabiting the galls of the oak-infesting Cynipidae,—they do not attack the true gall producer. They are vegetable feeders and not flesh consumers." *S. obtusilobae* is not included in Gillette's monograph.

Table I. Emergence Summary of The Gall Maker Group

Family	Genus	Species	1923 Emergence		1924 Emergence	
			First	Last	First	Last
Cynipidae	<i>Disholcaspis</i>	<i>mamma</i>		Annually in	late Oct. and early Nov.	
Cynipidae	<i>Synergus</i>	<i>obtusilobae</i>	May 25	June 9	One on	July 25
Callimomidae	<i>Syntomaspis</i>	<i>racemariae</i>	May 18	June 5	One on	July 20
Tetrastichidae	<i>Tetrastichus</i>	sp.	May 7	June 7		
Ichneumonidae	<i>Epiurus</i>	<i>indagator</i>	Two on April 27		June 30	July 7

Table I shows that the Hymenoptera reared from the larval cell of *Disholcaspis mamma* appeared over a period of forty-two days, or April 27 to June 9, in 1923, and a period of twenty-five days, June 30 to July 25, based on scanty records, in 1924. During the average of these periods, and according to the general life cycles of the gall maker forms *mamma* and *flavipes*, some of the species listed in the table obviously do not confine their attention entirely to the *mamma* gall maker. *Epiurus* appeared too early, and probably has other hosts than the gall inhabitant unless it be the *flavipes* form; the other three species are known to exist in such times as the *mamma* form is abroad, and their life histories may perhaps be so well tuned to that of *mamma* that the latter is alone an adequate host. It is recognized however, that considerable complexity may prove to occur in the parasite relationships as a result of the presumed long evolutionary process of the parasite cycles becoming conformed or paralleled to the specialized life histories of the cynipid hosts. The data now at hand rather indicates a relationship of primary parasitism on the parts of all to at least the *mamma* form of *Disholcaspis*.

(To be continued)

A PRELIMINARY REVISION OF THE CAMPOPLEGIINAE IN THE CANADIAN NATIONAL COLLECTION, OTTAWA.

BY HENRY L. VIERECK,

Ottawa, Ont.

(Continued from page 130).

Campoplex (Campoplex) moderatus n. sp.

Related to *C. fura* Cresson.

Female. Length 6 mm.; very much as in *C. sulcatellus* Vier. from which it

differs in addition to the characters given in the key, as follows.—Median and longitudinal carinae present on the propodeum, petiolarea transversely costate from side to side, areola finely sculptured, truncate at base; hind distal trochanters dark stramineous, their femora yellowish stramineous, extensor surface of hind tibiae, yellowish stramineous, darkened at base and apex, hind basitarsi mostly yellowish.

Holotype—♀, Eldorado, Hastings Co., Ont., Sept. 1, 1904, (Evans); No. 1673 in the Canadian National Collection, Ottawa.

Paratypes—♀ ♀, with same data as the holotype.

Campoplex (Campoplex) signatus n. sp.

Related to *C. grossulariflorae* Viereck.

Male. Length, 4 mm.; black, scape yellow in front, pedicel pale brownish in front, flagel black, palpi pale stramineous, mandibles mostly yellow, tegulae yellowish with a clear margin, fore and mid legs including their coxae pale stramineous, their end tarsal joint blackish, hind coxae black, brownish beneath at apex, hind proximal trochanters blackish, their distal trochanters stramineous, extensor surface of hind femora blackish, their flexor surface stramineous, flexor surface of hind tibiae stramineous, their extensor surface blackish at base and apex, stramineous in between, hind tarsi blackish, yellowish at base of basitarsi, abdomen black, a narrow apical margin on the second tergite, and a mark on each side of fourth tergite at base, yellowish, plica yellowish with blackish stains; areola apparently as wide as long, with the transversely costate petiolarea.

Holotype—♂, Aylmer, Que., August 8, 1924, (C. H. Curran); No. 1675 in the Canadian National Collection, Ottawa.

Campoplex (Campoplex) ruficoxalis n. sp.

Related to *C. grossulariflorae* Viereck.

This is what I regarded as *Angitia ruficoxa* Provancher, 1917, Hym. Conn. (265). The type of *Limneria ruficoxa* Provancher on examination appears to be a synonym of *Pseuderipternoides porrectus* Cresson.

Male. Length 5 mm.; compared with the original description of *C. signatus* Vier. this differs as follows.—Scape blackish brown in front, pedicel stramineous at apex, fore and mid coxae and all of fore and mid trochanters yellow, end joints of fore and mid tarsi pale, hind coxae and femora reddish, their proximal trochanters brownish stramineous with an apical yellowish margin, their distal trochanters yellowish, hind tibiae stramineous, their extensor surface blackish near base and at apex, yellowish at base, hind tarsi blackish, with the basal two-thirds of their basitarsi pale, first, second and third tergites with an apical stramineous margin, the sides of the second tergite near the apex, and most of the sides of the third tergite, stramineous; areola acute angled at base, as wide as long, weakly separated from the petiolarea, finely sculptured, costulae weak, petiolarea rather weakly transversely costate.

Holotype—♂, West Haven, Conn., June 27, 1905, (H. L. Viereck); Collection Conn. Agric. Exp. Station, New Haven, Conn.

Campoplex (Campoplex) hullensis n. sp.

Related to *C. vigilis* Viereck.

Female. Length 4 mm.; black, scape stramineous in front, rest of antennae black, mandibles mostly yellow, palpi pale stramineous, tegulae yellowish

with a clear margin, fore and mid legs including coxae, stramineous, hind coxae black, their proximal trochanters blackish and stramineous, their distal trochanters pale stramineous, their femora reddish stramineous, hind tibiae stramineous, faintly blackish at base and apex, hind tarsi blackish, their basitarsi mostly stramineous, abdomen black, the first tergite with an apical stramineous edge, the second tergite with an apical reddish margin, third tergite with the apical two-thirds mostly reddish, fourth tergite reddish, blackish down the middle, fifth and following tergites stramineous along the lower margin; areola nearly acute angled at base, finely reticulated, confluent with the petiolarea, the latter transversely costate; abdomen fusiform, sheaths of the ovipositor nearly as long as the abdomen.

Holotype—♀, Hull, Que., Aug. 26, 1894, (W. H. Harrington); No. 1674 in the Canadian National Collection, Ottawa.

***Campoplex (Campoplex) grimsbyensis* n. sp.**

Related to *C. grossulariflorae* Viereck.

Female. Length 5 mm.; black, scape and pedicel brownish stramineous at apex, mandibles mostly yellow, palpi stramineous, tegulae yellowish with a clear margin, mid coxae brownish stramineous, their trochanters yellowish, their femora nearly reddish stramineous, their tibiae with their flexor surface reddish, their extensor surface yellowish at base and in the middle, brownish near base and at apex, mid tarsi brownish, their basitarsi mostly stramineous, hind coxae black, their proximal trochanters blackish, with a yellowish apical margin, their distal trochanters yellow, femora reddish, faintly blackish at base and apex, hind tibiae with their flexor surface reddish and yellowish, their extensor surface, blackish near base and at apex, yellowish at base and in the middle, hind tarsi blackish with the basal half of their basitarsi yellowish, abdomen black, first and second tergites with an apical stramineous edge, sides of the third, fourth, fifth, sixth and seventh tergites mostly reddish, plica yellowish, with blackish stains; areola truncate at base, confluent with the petiolarea, transversely costate like the concave petiolarea; abdomen fusiform, its sheaths over half the length of the abdomen.

Holotype—♀, Grimsby, Ont., Sept. 30, 1894; No. 1680 in the Canadian National Collection, Ottawa.

***Campoplex (Campoplex) algonquinorum* n. sp.**

Related to *C. grimsbyensis* Viereck.

Female. Length 6 mm.; compared with the original description of *C. grimsbyensis* Vier. this differs as follows.—Palpi whitish, fore coxae pale stramineous, their trochanters yellowish, rest of fore legs dark stramineous, the apical tarsal joint blackish, mid tibiae hardly brownish near base, mid tarsi yellowish to stramineous with the apical joint blackish, hind proximal trochanters dark stramineous, hind femora reddish throughout, second tergite with a narrow reddish margin in the middle, third, fourth, fifth and sixth tergites with a narrow, apical, reddish margin that expands on the sides of these tergites to the extent of involving nearly all of the sides; areola acute angled at base, finely reticulated like the basal concave portion of the petiolarea, apical portion of petiolarea transversely costate; sheaths of the ovipositor apparently a little less than half the length of the abdomen.

Holotype—♀, Hemmingford, Que., August 31, 1916, (J. I. Beaulne); No. 1679 in the Canadian National Collection, Ottawa.

Campoplex (Campoplex) erythromera n. sp.

Related to *C. grimbyensis* Viereck.

Male. Length 7 mm.; compared with the original description of *C. grimbyensis* Vier. this differs as follows.—Antennae black throughout, mandibles blackish, fore coxae black, rest of fore legs stramineous, mid legs colored like the fore legs, hind proximal trochanters with an obscure stramineous margin, their distal trochanters blackish and dark stramineous, hind femora and tibiae reddish throughout, hind basitarsi reddish, blackish at apex, rest of hind tarsi blackish, abdomen black, apical third of second tergite pale stramineous with an apical blackish border, apical half and more of sides of third tergite dark stramineous, fourth tergite dark stramineous, blackish on the basal half in the middle, plica blackish with yellowish margins.

Holotype—♂, Jordan, Ont., September 20, 1917, (W. A. Ross); No. 1684 in the Canadian National Collection, Ottawa.

Campoplex (Campoplex) deceptivus n. sp.

Related to *C. ferruginosus* Viereck.

Female. Length 7 mm.; compared with the original description of *C. hullensis* Vier. this differs as follows.—Scape reddish brown in front, pedicel stramineous at apex, palpi whitish, extensor surface of fore and mid tibiae and their tarsi yellowish, hind coxae reddish-brown, their trochanters dark stramineous, hind tibiae blackish near base and at apex on the extensor surface, hind basitarsi whitish, blackish at apex, abdomen black or blackish, third tergite obscurely reddish at apex, plica yellowish, partly blackish; areola truncate at base, confluent with the petiolarea, partly feebly transversely costate, petiolarea slightly concave, coarsely transversely costate; abdomen truncate at apex, the sheaths of the ovipositor nearly three times as long as the truncature.

Holotype—♀, Kingsmere, Que., August 3, 1919, (R. W. Chrystal); No. 1678 in the Canadian National Collection, Ottawa.

Campoplex (Campoplex) macrurus n. sp.

Related to *C. ferruginosus* Viereck.

Female. Length 7 mm.; black, antennae black, save for the scape which is dark reddish in front, mandibles mostly yellow, palpi whitish, tegulae yellowish with a clear margin, coxae reddish, fore and mid trochanters yellowish, hind trochanters brownish stramineous, femora reddish, rest of fore legs pale stramineous with the apical tarsal joint blackish, mid tibiae brownish-stramineous, their tarsi blackish, hind tibiae and tarsi concolorous with the mid tibiae and tarsi, abdomen black, with a stramineous edge to most of the tergites, plica yellowish, slightly infuscated; areola and petiolarea confluent, slightly concave, transversely, finely lineolate, the areola narrowly truncate at base; abdomen fusiform, sheaths of the ovipositor nearly as long as the body.

Holotype—♀, Saanich, B. C., June 22, 1918, (W. Downes); No. 1681 in the Canadian National Collection, Ottawa.

Campoplex (Campoplex) arcanus n. sp.

Related to *C. macrurus* Viereck.

Female. Length, 7 mm.; compared with the original description of *C.*

macrurus Vier. this differs as follows.—Scape mostly yellow, pedicel yellow in front, palpi yellowish, lower margin of mandibles clear, reflexed, fore coxae stramineous, yellow at apex, mid coxae reddish, yellow at apex, hind trochanters dark reddish, fore and mid femora stramineous, yellowish at base and apex, fore tibiae with their flexor surface stramineous, their extensor surface and their tarsi yellowish, their basitarsi black at base on the flexor surface, rest of hind legs stramineous, the extensor surface of mid tibiae mostly yellow, their tarsi mostly yellowish, apical tarsal joint of fore and mid tarsi, brownish, hind femora and tibiae dark reddish, the extensor surface of the latter, blackish at apex, abdomen reddish with only the basal half of the petiole black, plica yellowish; confluent, areola and petiolarea finely sculptured, virtually planate, the former acute angled at base, abdomen sub-truncate at apex, the sheaths of the ovipositor barely exerted.

Holotype—♀, Caradoc, Ont., June 24, 1918, (H. F. Hudson); No. 1676 in the Canadian National Collection, Ottawa.

Campoplex (Campoplex) ultimus n. sp.

Related to *C. macrurus* Viereck.

Female. Length, 8 mm.; compared with the original description of *C. macrurus* Vier. this differs as follows.—Scape and pedicel brownish, the latter yellowish in front, palpi yellowish, fore and mid legs including coxae dark stramineous, their mid tarsi brownish, hind legs including coxae reddish, their tarsi blackish, abdomen black, the plica yellowish; areola and petiolarea virtually planate, transversely costate, abdomen fusiform, sheaths of the ovipositor apparently a little more than half as long as the abdomen.

Holotype—♀, Ottawa, Ont., August 22, 1897, (W. H. Harrington); No. 1682 in the Canadian National Collection, Ottawa.

Campoplex (Campoplex) militaris n. sp.

Related to *C. augustus* Viereck.

Female. Length 7 mm.; black, scape reddish black in front, rest of antennae black or blackish, mandibles mostly yellow, palpi yellowish, tegulae yellowish with a clear margin, fore and mid legs including coxae mostly stramineous, mid tarsal joints apically dark or blackish, the end joint blackish throughout, extensor surface of mid tibiae yellowish at base and in the middle, faintly darkened near the base, partly blackish at apex, hind coxae black, their trochanters and femora reddish, the latter blackish at apex, hind tibiae with their flexor surface reddish and stramineous, their extensor surface yellowish white at base and in the middle, black near the base and at apex, hind tarsi black, the basal two-thirds of the first joint, most of basal half of second, basal third of third, and extreme base of fourth joints yellowish, abdomen black, plica blackish, yellow at base; areola finely sculptured, truncate at base, confluent with the concave petiolarea that is transversely costate, and not separated from the second lateral area by a carina, abdomen fusiform, sheaths of the ovipositor a little longer than half the length of the abdomen.

Holotype—♀, Ottawa, Ont., (W. H. Harrington); No. 1677 in the Canadian National Collection, Ottawa.

Campoplex (Campoplex) jutus n. sp.

Related to *C. augustus* Viereck.

Female. Length, 7 mm.; compared with the original description of *C.*

militaris Vier. this differs as follows.—Scape black, mid tibiae near base and at apex and tarsal joints apically pale brownish, end joint of mid tarsi brownish, hind proximal trochanters blackish, dark stramineous at apex, their distal trochanters and femora dark stramineous, the latter blackish at apex, plica brownish and yellowish, sheaths of the ovipositor nearly half as long as the abdomen; petiolarea separated from the second lateral area by a well developed carina.

Holotype—♀, Sudbury, Ont., No. 85, July 29, 1889; No. 1683 in the Canadian National Collection, Ottawa.

Campoplex (Campoplex) ontario n. sp.

Related to *C. nolae* Ashmead.

Female. Length 7.5 mm.; black, scape and pedicel dark stramineous in front, rest of antennae black, mandibles mostly yellow, palpi stramineous, tegulae yellow with a clear margin, fore and mid coxae brownish stramineous, blackish at base and pale stramineous at apex, fore and mid trochanters yellowish, hind proximal trochanters blackish, dark stramineous at apex, their distal trochanters dark stramineous, hind coxae black, femora reddish, rest of leg stramineous excepting the hind tarsi which are mostly blackish, hind tibiae darkened at base and apex, abdomen black, plica yellow; areola truncate at base, confluent with the petiolarea, finely reticulated, the petiolarea transversely costate; abdomen obliquely truncate, nearly fusiform, sheaths of the ovipositor over twice the length of the apical truncature.

Holotype—♀, Ottawa, Ont., (W. H. Harrington); No. 1688 in the Canadian National Collection, Ottawa.

Campoplex (Campoplex) aylmerensis new species.

Presumably related to *C. nolae* Ashmead.

Female. Length 6.5 mm.; compared with the original description of *C. ontario* Vier. this differs as follows.—Antennae black throughout, mid coxae black, stramineous at apex, hind distal trochanters blackish with their flexor surface and apical margin dark stramineous, hind tibiae dark stramineous, black at base and apex; areola coarsely sculptured, very widely truncate, the base as wide as the apex of the petiolarea, the petiolarea slightly concave, the bottom of the concavity transversely costate; abdomen fusiform, sheaths of the ovipositor at least half as long as the abdomen.

Holotype—♀, Aylmer, Que., July 21, 1924, (C. H. Curran); No. 1685 in the Canadian National Collection, Ottawa.

Campoplex (Campoplex) angularis new species.

Related to *C. aylmerensis* Viereck.

Female. Length 5 mm.; compared with the original description of *C. ontario* Vier. this differs as follows.—Antennae black throughout, fore and mid coxae not black at base, hind, distal trochanters blackish, with their flexor surface and apical margin, stramineous, rest of fore and mid legs stramineous, hind femora reddish black, mid tibiae stramineous, black at base and apex and with the extensor surface blackish, areola narrowly truncate at base, virtually angulated, together with the petiolarea delicately transversely costate; abdomen fusiform, sheaths of the ovipositor apparently more than half as long as the abdomen.

Male. Characters essentially as in the holotype, mid coxae black at base, hind tibiae with the extensor surface brownish stramineous.

Holotype—♀, Norway Point, Lake of Bays, Ont., August 1, 1919, (J. McDunnough) No. 1686 in the Canadian National Collection, Ottawa.

Allotype—♂, same data but caught July 31.

Paratypes—♂♂, Aylmer, Que., July 15, 18, 21, 1924. In the paratype the mid coxae are pale at base and in two specimens the hind femora are reddish.

***Campoplex (Campoplex) cavus* new species**

Related to *C. angularis* Viereck.

Female. Length 4 mm.; compared with the original description of *C. ontario* Vier. this differs as follows.—Scape and pedicel blackish in front, palpi whitish, fore and mid coxae blackish, stramineous at apex, hind distal trochanters yellowish, hind femora blackish, mid and fore femora stramineous like most of the rest of the legs, hind tibiae dark brownish near base, blackish at apex, hind basitarsi with their basal three-fourths yellowish; areola acute angled at base; sheaths of the ovipositor distinctly more than twice the length of the apical truncature of the abdomen.

Holotype—♀, Ottawa, Ont., (W. H. Harrington); No. 1687 in the Canadian National Collection, Ottawa.

(To be continued)

NEW NORTH AMERICAN HALTICINAE (COLEOPTERA) WITH
NOTES ON OTHER SPECIES.

BY L. G. GENTNER,

East Lansing, Michigan.

This paper includes the descriptions of five new species of flea-beetles, three of which were among material sent me for identification from the Canadian National Collection, and also notes on the distribution and host plants of other species. I am indebted to Prof. H. C. Fall for verifying my determinations and for loaning me specimens for comparison; to Dr. Edwin VanDyke for sending me specimens; and to Dr. Henry Skinner for making comparison with type specimen.

Disonycha puncticollis Lec.—This species has been placed as a synonym of *D. quinquevittata* Say, but I believe that it should stand at least as a distinct variety. All of about fifteen specimens which I have seen from the Pacific Coast agree very closely with each other, and differ noticeably from the typical *quinquevittata* by the strongly alutaceous, dull, moderately coarsely punctured thorax, with greasy aspect, and by the fact that beneath, only the posterior part of the metathorax is dark at the middle.

Haltica corni Woods.—About twenty-five specimens were swept from *Cornus*, Sept. 23, 1925, Benzie County, Michigan. The *Cornus* formed a rather dense growth on the lowlands about a mile from Lake Michigan, and much of the foliage had been badly riddled and skeletonized by this insect. I have seen one other Michigan specimen, taken at Douglas Lake, Cheboygan County, July, 1917, (Melville H. Hatch). This species also occurs in Wisconsin, on *Cornus*. I have taken it at Madison from May to September. It has also been taken at Waupaca, Sturgeon Bay, and in Milwaukee County.

***Haltica canadensis* new species.**

Elongate oval, tending toward oblong, strongly convex, shining. Color above and below dark cupreo-violaceous, with distinct aeneous or bluish reflections in some specimens. Appendages black with metallic luster. Head and thorax

finely alutaceous, elytra more coarsely so. Head impunctate, except for a few coarse punctures near each eye and just above the tubercles, frontal carina prominent, tubercles moderately large, flattened, distinctly separated, strongly alutaceous, truncate above. Eyes small, their width as viewed from the front, less than one-third the interocular distance. Antennae about one-half the length of body, joints rather stout and short, 2-4 gradually longer, 4 two-thirds longer than 2. Thorax slightly more than one-half wider than long, distinctly narrower and more convex in front, sides on basal half sub-parallel, regularly arcuate to the front, margins narrow, front angles much thickened, ante-basal groove very broad, not reaching sides, front margin of groove nearly straight, narrowly, distinctly impressed, gradually shallower posteriorly to near base of thorax, posterior margin indistinct, sinuate, with a broad median lobe, each side of groove more deeply impressed, having appearance of a broad fovea, disk distinctly, moderately closely punctate, punctures not uniform in size, varying from fairly small to almost invisible. Elytra wider than thorax at base, more coarsely and closely punctate, punctures irregular in size, from moderately coarse to fine, gradually becoming less distinct toward apex, humeri obtuse, umbones distinct, a shallow depression within, sides sub-parallel, slightly arcuate, regularly rounded to apex. Abdomen alutaceous, moderately closely, finely punctate, somewhat pubescent. Male with last ventral segment having a very broad median lobe; and a very broad, deep, triangular impression, within which is a fine, impressed median line, extending the length of segment. First tarsal joint of anterior legs enlarged. Length 4.33-5.0 mm.; width 2.25-2.6 mm.

Type—male, Aweme, Manitoba, Canada, June 10, 1914, on rose, (N. Criddle); No. 2063 in Canadian National Collection.

Paratypes in author's collection and collections of U. S. National Museum. Ent. Dept., Michigan State College, and others.

Described from a series of twenty-eight specimens taken mostly at Aweme, Manitoba, on rose, (N. Criddle), from 1903 to 1920, during May to October. One specimen is labelled "Glendora, S. Criddle, 9-VI-20." I have two females from Edmonton, Alberta, May 24, 1919 (F. S. Carr), and one from Grainger, Alberta, April 20, 1922. Since writing this description, I have seen two specimens taken at Douglas Lake, Cheboygan County, Michigan, August, 1920 (Melville H. Hatch).

This species is quite distinct. It may possibly be confused with *H. tombacina* Mann., (*evicta* Lec.), near which it should be placed, but may be readily distinguished by its larger size, more elongate, subparallel form, cupreo-violetaceous color, more distinct punctation, the stouter antennae with relatively shorter joints. The last ventral of male has the most pronounced and conspicuous impression of any of the larger *Haltica* that have come to my notice.

Haltica foliacea Lec.—Typical specimens were taken in numbers at Belding, Mich., June 23, 1925, where they were feeding on and ovipositing on evening primrose, *Oenothera biennis* L. The eggs were from 1.0 to 1.12 mm. in length and slightly less than .5 mm. in width, subcylindrical with ends rounded or often subtruncate, slightly wider at one end, pale orange in color, with a frosty sheen. They were laid singly or in loose groups of from two to five in the axils of the leaves and on the young expanding leaves at the top. Some of the eggs had al-

ready hatched and the larvae were skeletonizing the leaves from both sides. The more advanced larvae were 3 to 5 mm. in length, dark-colored above, dirty yellowish below, with piceous head and legs. The body is covered with numerous setae-bearing tubercles, a double row of larger tubercles along each side. There is a prominent, oval, transverse, dark-colored blotch on each segment ventrally.

***Haltica elongata* new species.**

Elongate oval, convex, surface moderately shining. Color above and below black, with more or less bluish to purplish luster. Appendages black with some luster. Head with vertex smooth, finely alutaceous, frontal carina distinct, subacute, tubercles flattened, subtriangular, moderately distinct. Eyes small, their width as viewed from the front a little less than one-third the interocular distance, usually partly withdrawn into the thorax. Antennae slender, about one-half the length of the body in the males, shorter in the females, joints 2-4 successively longer, joint 4 twice the length of 2. Thorax about one-half wider than long, sides margined, distinctly narrowed in front, subparallel on basal half, front angles thickened, disk faintly alutaceous, extremely finely and sparsely punctate, ante-basal groove narrowly, not deeply, but distinctly impressed, quite straight, not reaching sides. Elytra not much wider at base than thorax, distinctly elongate-oval in outline, tapering behind middle to apex, humeri broadly rounded, umbones not prominent, surface distinctly alutaceous, uneven, somewhat rugose, punctures widely separated, somewhat coarser at base than those of thorax, very fine toward apex. Abdomen beneath alutaceous, moderately pubescent.

Male—Last ventral with a median lobe and a broad, triangular impression. First anterior tarsal joint enlarged. Length 3.88-4.5 mm.; width 1.75-2.2 mm.

Type—Male, Aweme, Manitoba, Canada, July 3, 1914 (N. Criddle), No. 2062 in Canadian National Collection.

Paratypes in author's collection, and in those of the Canadian National Collection, and Ent. Dept., Michigan State College.

Described from a series of eleven specimens, ten from Aweme, Manitoba, July 3, 1914 (N. Criddle), one from Cowley, Alberta (R. N. Chrystal). This species is quite distinct from any described *Haltica* known to me, because of its small eyes, great width between eyes, elongate-oval outline, tapering toward apex, by the fine, sparse punctation, and even surface of elytra, and because the head is not prominent when viewed from above. It is exceedingly variable, as shown by the small series before me. The coloration ranges from black to distinctly bluish and purplish. In one specimen, the prothorax is quite shiny, in another, the ante-basal groove is practically obliterated, and in still another the head is so far withdrawn into the thorax that it is scarcely visible from above. It probably should be placed just ahead of *H. polita* Oliv.

Crepidodera erythropus Melsh.—About forty-five specimens were taken near East Lansing, Mich., June 12, 1924, from a small clump of young locust trees growing on the north bank of the Red Cedar river, where they were feeding and mating.

Crepidodera atriventris Melsh.—This flea-beetle is common during July in the vicinity of East Lansing, Mich., where it badly riddles the foliage of *Acalypha virginica* L. I have also taken it here in March, April, May, June, September, October and December. During the winter months the adults may be found hibernating beneath fallen leaves. I have taken this species at Madison,

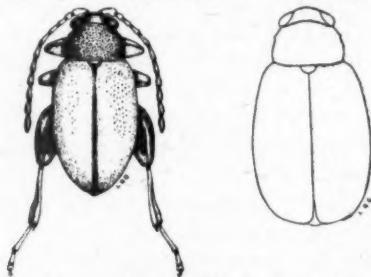
Wis., where it feeds upon the same host.

Systena hudsonias Forst.—Adults of this species were abundant at Caloma, Mich., June 9, 1925, feeding on *Solidago*. Many of the adults had apparently but recently matured, as they had not yet become fully colored.

***Longitarsus menthaphagus* new name.**

To replace *Longitarsus menthae*, which name was unfortunately established by the publication of a drawing of the male in connection with a preliminary note on the habits of this insect.* The technical description has never been published and is being given in the present paper. Dr. Heikertinger, of Austria, has kindly informed me that the name *menthae* had already been used for a European species, therefore, the change of name.

Males elongate-oval, convex, wingless. Females broadly oval, convex, winged. Color above, except head, light brownish-yellow, with the prothorax, scutellum and sutural line darker. Head dark reddish-brown, with front often paler. Labrum piceous. Eyes black. Antennae with basal five joints brownish-yellow, outer joints quite dark. Legs light brownish-yellow, except hind femora, which are darker, and which have a still darker reddish-brown blotch showing through the integument. Color, below, except prothorax, dark brown to piceous, abdomen usually paler at tip. Prothorax colored as above.



Adult male (left) and female (right) of mint flea-beetle, *Longitarsus menthaphagus* n. sp., enlarged.

Head distinctly alutaceous, impunctate, except for a few punctures near each eye, frontal carina prominent, antennal tubercles very narrow, obliquely transverse, limited above by an impressed line. Antennae three-fourths or more the length of body, joints 2-5 gradually longer, 5 almost twice as long as 2. Thorax somewhat quadrate, less than one-half wider than long, sides arcuately rounded, but slightly narrowed in front, anterior angles obliquely truncate, disk moderately shining, more or less rugulose and faintly alutaceous, moderately coarsely and closely punctate. Elytra with tips separately rounded to suture, somewhat subtruncate, pygidium visible; in the males the elytra scarcely wider at base than thorax, sides quite regularly rounded, humeri feeble, umbones scarcely visible; in the females elytra distinctly wider at base than thorax, humeri obtuse, umbones distinct, limited within by a slight depression; disk shining, more coarsely, but less distinctly and less closely punctate than thorax, punctures more distinctly impressed at base and near scutellum, somewhat less so at apex. Abdomen shining, sparsely, indistinctly punctate, quite smooth along sides, last ventral a little more densely punctate and not quite so shiny, segments somewhat transversely wrinkled.

*—Mich. Expt. Sta. Quart. Bul., Vol. 7, No. 3, Feb. 1925.

Male—Last ventral segment with a prominent median lobe, feebly flattened with a faintly impressed median line running the length of segment. First anterior tarsal joints enlarged. Length, males 1.75-2.25 mm.; females 2.0-2.6 mm.

Type—Male, Mentha, Mich., Oct. 15, 1924 (L. G. Gentner), in collection of Entomology Dept., Michigan State College.

Allotype—Same date as type.

* *Paratypes* in author's collection, and in collections of U. S. National Museum, Canadian National Collection, Brooklyn Museum, Cambridge Museum of Comparative Zoology, and others.

Described from a large series of specimens collected at Mentha, Campania (near Fennville) and Decatur, Mich. This species has been given the name of the "mint flea-beetle." It differs from all other known species of North American *Longitarsus* in that the males are wingless and the females winged. The former would come under the subgenus *Apterius* and the latter under the subgenus *Longitarsus* of Blatchley's "Key to the Eastern Species of *Longitarsus*."* In newly emerged specimens the prothorax is nearly as pale as the elytra, but in well-matured specimens it takes on a darker hue. The darker head and darker blotches on the hind femora show up distinctly even in recently emerged specimens. The darker shading along the suture varies, being very distinct in some, while scarcely noticeable in others. The punctation is fairly constant. The color of the under side varies from slightly darker than the upper side to nearly black.

The mint flea-beetle is probably the most important factor which limits the period that cultivated peppermint and spearmint may be successfully "kept in the ground." Its ravages have usually been laid to other causes. It has been causing serious losses to Michigan mint growers for many years, and more recently, to those of northern Indiana. Its only known food plants are those belonging to the mint family, and it may have fed originally on native mint. The adults appear during July, and after feeding on mint foliage for three or four weeks, begin egg-laying. Egg-laying may extend into December, or until more or less continual freezing sets in. The eggs are about one-fortieth of an inch in length, elongate-oval, orange-yellow, and are laid singly, either on the soil surface or between soil particles. They are covered up when the mint sod is plowed under, and hatch during May of the following year. The larvae feed on the small rootlets of the mint plants and mine beneath the epidermis of larger roots and underground parts of stems, badly stunting or killing the plants. The mature larvae are about 5 mm. in length, whitish in color, with a shining, pale-brown head, and are sparingly covered with whitish hairs. They pupate in oval, earthen cells, usually within the upper three inches of soil. The pupal stage is of about three or four weeks duration.

Longitarsus ovalis new species.

Rather broadly oval, strongly convex, shining, apterous. Color above pale brownish-yellow, except head which is reddish-brown; below darker, brownish in color. Antennae and legs same color as above, except hind femora, which are darker. Head impunctate, vertex alutaceous, moderately shining, labrum picuous. Antennae slender, joints 2 and 3 subequal, 4 one-half longer than 2. Thorax one-half wider than long, sides moderately arcuate with an indication of an

*—Jour. N. Y. Ent. Soc., XXIX, No. 1, p. 18.

angle behind middle, anterior angles distinctly obliquely truncate, disk moderately alutaceous, punctures fine, well separated. Elytra not wider at base than thorax, regularly, broadly oval, widest at about middle, distinctly convex, humeri absent, umbones faint, disk very faintly alutaceous, strongly shining, punctures extremely fine, distinct, widely separated, somewhat finer than those of thorax, more distinct, and somewhat closer along basal margin, becoming indistinct beyond middle and toward sides. Abdomen beneath moderately shining, somewhat alutaceous toward apex, sparsely punctate, more densely toward tip.

Male—Last ventral segment with a prominent median lobe, bearing a distinctly impressed, dark-colored, median line, extending the length of segment. First anterior tarsal joint enlarged. Length 2.12-2.5 mm.

Type—Female, St. Johns, Newfoundland, (A. English); No. 2061 in Canadian National Collection.

Allotype—Male, same data as type.

Paratypes—In author's collection.

Described from seven specimens, all taken at St. John's, Newfoundland (A. English). Not any of these had all of the appendages intact. The type specimen has only one antenna. This species is the largest of the apterous North American forms. It is the only species known to me among those in which both sexes are wingless, that has joint 4 of the antennae distinctly longer than 2. One specimen, apparently discolored, was much darker than the others. The tip of the pygidium is visible below the apical margin of the elytra. This species should be placed after *menthaphagus*, which species forms a bridge between the winged and wingless species.

Phyllotreta liebecki Schffr.—This species was described from specimens from Enterprise, Florida.* Prof. W. S. Blatchley records it as common at Sanford, Florida.* In addition to Florida specimens from Dunfull, Sanford, Sarasota (Blatchley), I have examined three specimens from Liberty, Texas, April 5, 1923 (L. J. Bottimer) and six specimens from Georgia, in collection of Ent. Dept., Michigan State College.

Psylliodes elegans Horn.—I am strongly of the opinion that *elegans* should be considered as a variety of *P. convexior* Lec., rather than as a distinct species. I have taken large series of the latter on wild peppergrass (*Lepidium virginicum* L.) at Lawton, Belding, and Beulah, Mich. Associated with these, there was always a considerable number of the forms with the blue elytra, which would be placed as *elegans*, according to the present classification. These differed only in the coloration of the elytra. I can find no consistent difference between Michigan and Florida specimens of *elegans*, except that the latter have the antennae and legs slightly paler. The Florida specimens are not always a little broader than *convexior* as Horn states,* but the breadth varies considerably in both species. A series of *elegans* from Florida, purchased from Prof. Blatchley, included three specimens of *convexior*.

*—Jour. N. Y. Ent. Soc., XXVII, No. 4, Dec., 1919, p. 339.

*—Can. Ent., LII, No. 11, Nov., 1920, p. 263.

*—Trans. Am. Ent. Soc., XVI, July, 1889, p. 312.

DESCRIPTIONS OF TWO NEW SPECIES OF PLATYCHEIRUS
(SYRPHIDAE, DIPTERA).*

BY F. P. IDE,

Ottawa, Ont.

The two species of *Platycheirus* here described were contained in a lot of undetermined material following the named species in the Canadian National Collection. The number of Canadian species in the collection is nineteen, of which ten, *discimanus* Lw., *peltatus* Meig., *podagratus* Zett., *scutatus* Meig., *albimanus* Fabr., *clypeatus* Meig., *perpallidus* Verr., *scambus* Staeg., *immarginatus* Zett., and *angustatus* Zett., were originally described from the Palaearctic region.

***Platycheirus modestus* n. sp.**

Length, 7 to 7.5 mm. *Male*. Face and frontal triangle shining black moderately yellowish grey pollinose, the pollen more yellowish on the frontal triangle, lacking on facial tubercle and on the anterior oral margin. Hairs on the face fairly abundant, rather short and mostly pale in color. On the frontal triangle the hairs are longer and black. Space before jowls shining black; jowls themselves and the back of the head covered with yellowish-grey pollen which becomes less dense towards the upper part and on the vertical triangle; the pile on these is blackish becoming longer on the cheeks and quite long towards the upper part and on the vertical triangle. Antenna blackish brown; arista dark brown, about as long as an antenna.

Thorax and scutellum intensely shining blackish with rather abundant, mostly equal, tawny pubescence which is longer on the scutellum. Pleura grey pollinose, the mesopleura with long silky golden-yellow hairs on posterior portion.

Abdomen orange except for the basal segment which is black; the following segment narrowly black basally, (except the sides) more broadly so in the middle. Sometimes each segment bears a linear blackish apex. Genitalia shining black. Venter orange. Pubescence on the abdomen rather short and light in color, longer along the edges.

Front legs reddish orange, trochanter and coxa blackish. Front femora with a brownish patch posteriorly beginning at the base and extending about one half its length. Hairs yellowish, fairly short, longer at the posterior edge of tibia. Hairs on brown patch on posterior side of front femur quite long and brownish. Front femur without the long angularly curved group of hairs at the base. Distal end of tibia whitish; the proximal segment of tarsus also more whitish than rest of tarsus. Anterior margin of tibia almost straight; tibia gradually dilated from the base being about twice as broad at the apex as at the base. Outer apex of tibia produced as a small triangle. First segment of tarsus set obliquely in its insertion on tibia; slightly narrower than the apex of the tibia; twice as long as broad. The following three segments gradually diminish in length and breadth, about as broad as long. Middle legs reddish-orange. On the femur at the distal end toward the front and almost beneath, are five to six long bristly black hairs in a row as in *P. perpallidus*. Otherwise pubescence short and yellowish. Hind legs reddish-orange. Proximal segment of tarsus black. Sometimes a black indistinct band near the base of the tibia. Pubescence short and yellow.

Wings brownish, rather tawny at the base. Halteres orange.

Holotype—♂, Megantic, Que., June 22, 1923. (C. H. Curran); No. 1300 in the Canadian National Collection, Ottawa.

Paratypes—2♂, same data; ♂, Megantic, June 18, 1923, (Curran); ♂.

Fredericton, N.B., July 5, 1923, (J. D. Tothill); 2 ♂, Lowbush, Ont., June 21, and July 29, 1925, (N. K. Bigelow).

This species belongs to the *quadratus* group and differs from all allied species by lacking long white hairs at base of anterior femora.

***Platycheirus inversus* n. sp.**

Length, 9.5 to 10 mm. *Male*. Face and frontal triangle shining brownish-black, moderately yellowish-grey pollinose except around the base of the antennae, the facial tubercle and the anterior oral margin. Hairs fairly abundant, dark and rather short, longer and blacker on the frontal triangle. Cheeks black, moderately light grey pollinose, back of head more densely pollinose. Antenna dark brown on the upper and outer half and yellowish brown on the inner and lower half; arista dark brown and about as long as an antenna.

Thorax and scutellum shining black with rather abundant short tawny pile, scutellum with longer pile. Pleura grey-pollinose. The mesopleura with long, light-colored silky pile posteriorly.

Basal segment of abdomen black; following segment with fairly wide black median vitta and with black fasciae of about the same width along both the anterior and posterior margins, the remainder of segment yellow; following three segments similar except that there is no black basal fascia. Genitalia shining black. Venter yellow becoming dark towards the sides and the posterior end. Pubescence light colored, darker on black parts of abdomen; very long and silky basally, becoming shorter posteriorly.

Coxae and trochanter of front leg blackish-brown; femur also blackish brown on its basal half grading into whitish yellow on the apical half; remaining parts of leg whitish except for a dark brownish spot on the tibia near apex of posterior side. Along the posterior side of the femur are a group of coarse long black bristles. Hairs along posterior margin of tibia yellowish except on the dark brown spot where they are black. Hairs on remaining parts of front leg short and yellow. First segment of tarsus very large and flattened; twice as long as broad, the inner corner of apex projected into a triangle beyond the joint. Second segment of tarsus larger and wider than the following two segments. Middle leg more brown than front leg, the tibia curved or bowed inwards in the apical half. Hind leg brown everywhere except the knees. Basal segment of hind tarsus with distinct blackish brown swelling on proximal half. Hairs black and spiny on outer side of tibia and tarsus and yellow on inner side.

Wings brownish; halteres yellowish-brown.

Holotype—♂, Hull, Quebec, May 30, 1903, (W. H. Harrington); No. 1301 in the Canadian National Collection, Ottawa.

Paratype—♂, Weymouth, N.S., June 2, 1911.

Allied to *peltatus* Meigen and *peltatoides* Curran from both of which the ♂ is readily distinguished by the remarkably swollen basal half of the posterior metatarsus. The three species of this group may be separated as follows:

1. Posterior basitarsus almost twice as large on basal half as on apical half, suddenly narrowed *inversus* Ide.
Posterior basitarsus only moderately enlarged, evenly tapering 2.
2. Halteres wholly pale; mesopleura wholly yellow pilose *peltatus* Mg.
Halteres with the knob deep brown; mesopleura with considerable black pile *peltatoides* Curr.

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